Study on dung beetles (Coleoptera: Scarabaeidae: Scarabaeinae) of northern Pakistan with a new record from Pakistan

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Abstract: This study investigates the dung beetle fauna in northern Pakistan, including Khyber Pakhtunkhwa province, Gilgit-Baltistan (formerly known as the Northern Areas of Pakistan), and Federally Administered Tribal Areas, based on collections and determined specimens. The area is diverse and contains a variety of flora and fauna pertaining to different habitats. We conducted surveys in the Alpine Zone, Montane Temperate Forest and Tropical Deciduous Forest. Three genera and five species, *Digitonthophagus gazelle*, *Digitonthophagus bonasus*, *Heliocopris midas*, *Heliocopris bucephalus* and *Gymnopleurus flagellates* were collected. Identification keys and distribution notes are provided. *Heliocopris bucephalus* was found to be a new country record to Pakistan.

Key words: Scarabaeioidea; dung beetles; taxonomy

巴基斯坦北部蜣螂亚科分类及一个巴基斯坦新纪录（鞘翅目：金龟甲科：金龟甲亚科）

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摘要：巴基斯坦北部地区，包括 3 个省级地区：开伯尔-普什图省 Khyber Pakhtunkhwa、吉尔吉特-巴尔蒂斯坦特区 Gilgit-Baltistan（曾被称为巴基斯坦北部特区 the Northern Areas of Pakistan）、联邦直辖部落地区 Federally Administered Tribal Areas）。这里生境类型多样，动植物种类丰富。由于种种原因，该地区的标本难以获取，其动物区系的研究也近乎停滞。本文通过较为详尽的调查，基于来自国际上多家博物馆的模式标本和定名标本，对巴基斯坦北部地区蜣螂亚科进行了系统研究，共发现了 3 属 5 种蜣螂（*Digitonthophagus gazelle*, *Digitonthophagus bonasus*, *Heliocopris midas*, *Heliocopris bucephalus* and *Gymnopleurus flagellates*），编制了该地区蜣螂亚科的分类检索表，发现了 1 个巴基斯坦新纪录蜣螂（*Heliocopris bucephalus*）。本研究对于认知和了解巴基斯坦的动物区系具有一定意义。

关键词：金龟甲总科；蜣螂；分类

Introduction

Despite their immense diversity, the Scarabaeinae fauna of northern Pakistan have not been investigated in depth. Although a well-documented taxonomic work on the Oriental dung

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beetle fauna had been carried out by Arrow (1931) and Balthasar (1963a, b), there is no information available about the diversity, distribution and ecology of the scarab fauna of northern Pakistan. The Catalogue of Palaearctic Coleoptera listed 70 species of Scarabaeinae from Pakistan, but not even a single species has been documented from Northern Pakistan, including Khyber Pakhtunkhwa province, Gilgit-Baltistan (formerly known as the Northern Areas of Pakistan), and Federally Administered Tribal Areas (Löbl & Smetana 2006).

There are also a series of non-coprophagous scarab beetle publications from Pakistan (Abdullah & Roohi 1968, 1969). There are more or less 18 pronounced climatic regions in Pakistan. The present study areas in the northern parts of Pakistan have diverse macro and micro-climate zones: alpine zone (alpine meadows, sub-alpine scrub and birch forest, and alpine dry steppe), montane temperate forest (sub-tropical pine forest, Himalayan moist temperate forest, Himalayan dry temperate forest), and tropical deciduous forest.

We provide the identification keys, distribution and description of the species collected from all possible localities among the study areas of northern Pakistan to add to our knowledge of the faunal composition of scarabs occurring in Pakistan. One species, *Heliocopris bucephalus*, is recorded in Pakistan for the first time.

Material and methods

Materials are deposited in the following institutes or private collections; abbreviations are as shown in the text:

CABI — Centre for Agricultural Bioscience International Rawalpindi.

IZAS — Institute of Zoology, Chinese Academy of Sciences, Beijing, China.

MNHN — Muséum National d'Histoire Naturelle, Paris, France.

NHML — The Natural History Museum, London, UK.

NIM — National Insect Museum, Islamabad, Pakistan.

NMPC — National Museum (Natural History), the Department of Entomology, Prague, Czech Republic.

PMNH — Pakistan Museum of Natural History, Islamabad, Pakistan.

ZIN — Russian Academy of Sciences, Zoological Institute, St. Petersburg, Russia.

ZMUC — University of Copenhagen, Zoological Museum, København [= Copenhagen], Denmark.

Sampling Areas

The present studies were conducted in three habitats viz., Alpine Zone, Montane Temperate Forest and Tropical Deciduous Forest. For a comprehensive investigation, these regions were further divided into sub regions.

Alpine Zone

The Alpine Zone was typified by continuous grass fields dotted all over with tumbled boulders. Alpine zones were subdivided into Alpine meadows, Sub Alpine scrub and Birch forest and Alpine dry steppe.

Alpine Meadows. Alpine meadows occurred in the Northern Hazara District, Chitral, Swat, Kohistan and all regions where mountains extend above the coniferous forest tree line.

Sub-alpine Scrub and Birch Forest. This area consists of upper slopes throughout higher

mountain range of the Himalayas, including the north-eastern corner of Hazara District, Swat and Kohistan.

Alpine Dry steppe. This is typified by the side valleys of lower Chitral Kohistan, the western border of Waziristan, and some parts of Safed Koh, Malakand, Swat and Dir.

Montane Temperate Forest

Montane temperate forests, which are the only real "tall tree" forests in Pakistan, include the following sub regions:

Sub-tropical Pine Forest. This fairly narrow zone ranging between 3000ft and 6500ft is found in the lower Kaghan Valley around Kuwai, Batrassi Pass (Hazara) and lower Swat around Marghazar and Bunair.

Himalayan Moist Temperate Forest. This is predominantly a coniferous forest with high rainfall during the monsoon season and with glades of mixed deciduous broad-leaved species. Parts of Eastern Swat, Indus Kohistan, lower Kaghan, Shogran, Murree Hills and Kohistan are included in this subregion.

Himalayan Dry Temperate Forest. This consists of the inner and northern ranges of the Himalayas confined to the more sheltered lower slopes including Jabba Valley in Swat, Dir, Chitral, the Inner valleys of Hazara, Indus Kohistan and Swat Kohistan.

Tropical Deciduous Forest. Rawalpindi foot-hills, Margalla Hills, Kahota, Lethrar, and Noor Pur Shahan collectively form the tropical deciduous forest.

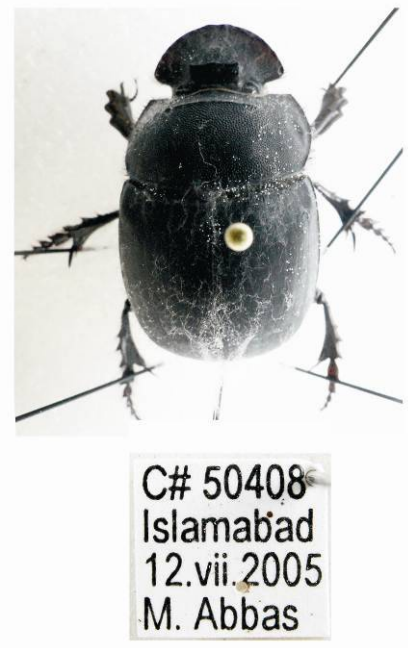

Figure 1. Specimen preservation sample from Pakistan Museum of Natural History (PMNH) Islamabad.

Specimens were collected by hand picking and using light traps. The collected specimens were manually stored in vials containing 70% ethanol solution. All specimens were transferred to the insect repository of the Pakistan Museum of Natural History (PMNH) Islamabad for systematic study. Specimens were properly prepared and catalogued as shown in Fig. 1.

Identification of the specimens was done at the Pakistan Museum of Natural History (PMNH) Islamabad with the help of references and determined materials from the IZAS, MNHN, NHML, ZMUC, ZIN, NMPC, PMNH, CABI and NIM. Some of the specimens were identified by comparing specimens with the collections in CABI and NIM.

The taxonomic characters of the specimens were examined using a Kyowa Optical microscope (Model SDZ-P) Japan.

Taxonomy

Key to genera of Scarabaeinae from Northern Pakistan

1.Head and pronotum without horn or ridges, middle coxae not widely separated····· *Gymnopleurus* Illiger

-. Head and/or pronotum with horn or ridges, middle coxae widely separated····· 2

2. Second palpomere longer than first palpomere, third palpomere very short even absent·····
····· *Digitonthophagus* Balthasar

-. Second palpomere shorter than first palpomere, third palpomere always present and long··· *Heliocopris* Hope

Genus *Digitonthophagus* Balthasar, 1959

Digitonthophagus Balthasar, 1959, *Sbornik Entomologica Musei Nationalis*, 33: 464. (Type species: *Scarabaeus bonasus* Fabricius, 1775).

Key to species of *Digitonthophagus* Balthasar, 1959

1. Semicircular head with the front margin. Forehead is finely punctured and divided from the clypeus by a strong curved carina. Elytra are finely striate and unpunctured. Pygidium bears an angulate basal carina and a few scattered punctures····· *D. gazella* (Fabricius)

-. Semicircular head with the front margin. Clypeus is lightly granulated and is separated from the forehead which is more sparsely granulated by a strong curved carina. Elytra are finely striate with extremely few and minute punctures. Pygidium bears an angulate basal carina and similarly light and minute punctures·····
····· *D. bonasus* (Fabricius)

1. *Digitonthophagus gazella* (Fabricius, 1787) (Fig. 2)

Scarabaeus gazelle Fabricius, 1787, *Manitoba Entomologist*, 2: 377 (ZMUC).

Scarabaeus dorcas Olivier, 1789, *Entomologie*, 1(3): 121.

Copris antilope Fabricius, 1798, *Supplementum Entomologicae Systematicae*: 32.

Copris metallicus Fabricius, 1798, *Supplementum Entomologicae Systematicae*: 28.

Onthophagus intermedius Reiche, 1840, *Revue de Magasin de Zoologie*, 3: 243.

Digitonthophagus gazella: Balthasar, 1959, *Sbornik Entomologica Musei Nationalis Pragae*, 33: 464.

Diagnosis. Head is semicircular with the front margin. Forehead is finely punctured and divided from the clypeus by a strong curved carina. Clypeus in male is slightly rugulose and shining. Clypeus in female is slightly rugulose and thick. The vertex bears a straight carina. Pronotum bears thin granules in its median part. Elytra are finely striate and unpunctured. Pygidium bears an angulate basal carina and a few scattered punctures. The metasternum bears only a few punctures.

Specimens examined.

[PMNH] 2♂4♀, Buner, 22-VIII-2007; 3♂, Mansehra, 13-VII-2011; 4♀, Abbottabad, 09-VIII-2012; 2♀, Peshawar, 10-VII-2013.

[NHML] S. W. Africa, Barby Farm, 25 mls, 17–18-I-1972, 2♂4♀, W. Helmeringhausen Coll.; Arabia, Sabya, 04-II-1937, 5♂3♀, H. St. J. B. Philby Coll.; Tanganyika Terr, Old Shinyanga, 26-I-1934, 2♂2♀, E. Burtt Coll.; Madagascar, Majunga S. L., V-1968, 1♂4♀, S. Key Coll.

[NMPC] Ceylon, 2♂1♀, leg. Fruhslorfer; Diego Suarez, 3♂2♀, leg. Dr. Martin; Indien, S. O. Mysore, Harikar-Vilayangi, 1933, Sammlung Priefert, 4♂3♀, leg. Dr. Waidschmidt.

[ZIN] 1♂, Afghan, 27-IV-1971, leg. Kabakov.

Distribution. India; Baroda; Mauretania; Belgium; Sri Lanka; W. Africa; Kenya; Japan; U.S.A. (Texas, introduced); Malawi; Senegal; Australia (introduced); Madagascar; Arabia; Central and South America (introduced).

Remarks. This species is distinct on the basis of horn present on clypeus and having no tubercle in middle. Siddiqui and Kamaluddin (2011) reported this species from buffalo and

cow dung from different areas of Pakistan. Collected specimens show resemblance with the published description given by Arrow (1931).

Figure 2. *Digitonthophagus gazella* (Fabricius, 1787).

2. ***Digitonthophagus bonasus*** **(Fabricius, 1775)** (Fig. 3)

Scarabaeus bonasus Fabricius, 1775, *Systema Entomologiae*: 23 (ZMUC).

Digitonthophagus bonasus: Balthasar, 1959, *Sbornik Entomologica Musei Nationalis Pragae*, 33: 465.

Diagnosis. Head is semicircular in shape with the front margin. The clypeus is lightly granulated and is separated by a strong curved carina from the forehead which is more sparsely granulated. A short acute erect horn is in the middle of the fore-head. The vertex bears a pair of horns. Pronotum is very smooth in front and behind with a few scattered granules in its middle part. There is a slight median groove on each side. Elytra are finely striate with extremely few and minute punctures. The middle and hind femora are short and broad. The tibiae are externally strongly toothed. Pygidium bears an angulate basal carina and similarly light and minute punctures.

Specimens examined.

[PMNH] 4♂5♀, Kanju, 12-VII-2007; 2♂1♀, Swat, 10-VII-2008; 5♂, Mansehra, 13-VII-2011; 4♀, Swabi, 26-VII-20013.

[NMPC] Mysore state India 1♂.

Distribution. India; Sri Lanka; Bengal; Myanmar; Thailand; South Afghanistan; Vietnam; Cambodia and Belgium.

Figure 3. *Digitonthophagus bonasus* (Fabricius, 1798).

Comments. Previously recorded by Arrow (1931) from Pakistan. Specimens were similar

to the published description given by Arrow (1931). This species is distinct on the basis of the horn present on clypeus and having tubercle placed in middle with slight basal tooth at inner edge. It is similar to *Digitonthophagus gazelle* on visual external morphology (Syed *et al.* 1981).

Genus *Heliocopris* Hope, 1837

Heliocopris Hope, 1837, *Coleopterist's Manual*, 1: 23 (Type species: *Scarabaeus gigas* Fabricius, 1758, by original designation, deposited in ZMUC).

Key to the species of *Heliocopris* Hope, 1837

1. Medial gibbosity on the pronotum less tapering toward the head end, comparatively shorter, its anterior margin broadly truncate and emarginate. Median division of the cephalic-shield protuberance not emarginate in the middle····· *H. midas* (Fabricius)

-. Gibbosity on the pronotum occupies almost the entire width, distinctly surrounded ridge-like toward the head end and simply bent. The pronotum is more or less transverse, smooth and ridged. Head with a horn and pronotum with well-developed gibbosity. Elytra very smooth, shiny and with very delicate striae. Pygidium covered with scattered punctures····· *H. bucephalus* (Fabricius)

3. *Heliocopris midas* (Fabricius, 1775) (Fig. 4)

Figure 4. *Heliocopris midas* (Fabricius, 1775).

Scarabaeus midas Fabricius, 1775, *Systema Entomologiae*, 1: 21 (NHML).

Heliocopris midas: Bates, 1868, *Coleopterologische Hefte*, 4: 87.

Diagnosis. The pronotum is less tapering toward the head end and relatively shorter, its anterior margin more broadly truncate and also more broadly emarginated but the emargination hardly narrower than the median emargination of the cephalic shield. Median

division of the cephalic-shield protuberance is not emarginated in the middle.

Specimens examined.

[PMNH] 1♂2♀, Mansehra, 03-VIII-2006; 4♂5♀, Buner, 11-VIII-2007; 1♂2♀, Dir, 27-VII-2012; 2♂1♀, Peshawar, 12-VII-2012.

[NHML] Unknown, 1♀ (Type)

Distribution. India; Southern Asia and China.

Remarks. This species is previously recorded by Hashmi and Tashfeen (1992) from southern Pakistan. The present record extends the distribution of this species to northernmost Pakistan. This species is plentiful in the coprophagus environment at lower elevations. The specimens were usually collected away from the dung.

4. ***Heliocopris bucephalus* (Fabricius, 1775)** (Fig. 5), new record to Pakistan

Scarabaeus bucephalus Fabricius, 1775, *Systema Entomologiae*, 1: 24 (NHML).

Scarabaeus cristatus DeGeer, 1778, *Mémoires Pour Servir à L'histoire des*, 7: 636, t.47, f. 5♀.

Heliocopris tmolus Fischer von Waldheim, 1822, *Entomographie de la Russie*, 1: 13, f. 2♀.

Diagnosis. Large pronotum covers the head with a strong clypeus underneath. The color is reddish-brown to black. Clypeus covers the biting mouth parts. A pair of compound eyes and lamellate antennae. The front wings are hard and there is a cover sheath of membranous hind wings. Females have no horn. The males have three horns, one on the clypeus and two on the pronotum. The elytra very shiny and smooth with very lightly impressed delicate striate. The pygidium covered with delicate scattered punctures.

Figure 5. *Heliocopris bucephalus* (Fabricius, 1775).

Specimens examined.

[PMNH] 2♂1♀, Abbottabad, 11-VII-2007; 3♂4♀, Kohat, 11-VIII-2010; 4♂, Kurram Agency, 11-VII-2012; 2♂3♀, Besham, 11-VIII-2012; 2♂1♀, Peshawar, 11-VIII-2013.

[IZAS] China, Zhejiang, Yongkang, 880 m, 06-VI-1980, 1♀, leg. Xifu WANG; China, Hainan, Wanning, 60 m, VI-1963, 1♀, leg. Baolin ZHANG; China, Yunnan, Xishuangbanna, Xiaomengyang, 850 m, 14-VI-1957, 1♀, leg. Shuyong WANG; China, Yunnan, Jinghong, Damengla, 650 m, 23-VII-1980, 1♂, leg. Yunming LI. Indonesia, Sumatra, ?-?-1906, 1♂1♀.

[NHML] Unknown, 1♂ (Type); India, Calcutta, Simson, 1♂, Fry Coll. 1905-100[?]; 1♀,

H. Swale 1913-117[?]; Cachin Hills, 1♂, H. I. Stanton Coll. 97-195; Java, 1♀, B. M. 1924-486[?]; 1♂, Claude Morley Collection, B. M. 1952-159[?]; N. W. India, 1♀.

Distribution. Indian subcontinent; Southeast Asia and Southern China.

Remarks. This species constitutes a new country record to Pakistan. This species is commonly found in the foothill environments, pastures and forest edges in loamy soil and well-drained sandy clay.

Genus *Gymnopleurus* Illiger, 1803

Gymnopleurus Illiger, 1803, *Magazin für Insektenkunde*, 2: 199 (Type species: *Ateuchus flagellatus* Fabricius, 1787, by original designation, deposited in ZMUC).

Spinigymnopleurus Shipp, 1897, *Entomologist*, 30: 168 (Type species: *Gymnopleurus tristis* Laporte, 1840).

Progymnopleurus Garreta, 1914, *Bulletin de la Société Entomologique de France*: 52.

5. *Gymnopleurus flagellates* (Fabricius, 1787) (Fig. 6)

Scarabaeus flagellates Fabricius, 1787, *Magazin für Insektenkunde*, 1: 17 (Type specimens transferred from ZMUK to ZMUC).

Copris flagellatus: Olivier, 1789, *Entomologie*, 1(3): 162; 1790: 174.

Scarabaeus coriarius Herbst, 1789, *Naturgeschichte Kafer*, 2: 309.

Ateuchus flagellatus: Fabricius, 1801, *Systema Eleutheratorum*, 1: 59.

Gymnopleurus serratus Fischer von Waldheim, 1821, *Lettre a Pander*: 11. –Olsoufieff, 1918, *Mémoires du Musée du Caucase*, 7(A): 38, 77 (Syn.).

Gymnopleurus clypeolatus Mulsant, 1842, *Coléoptères France Lamellicornes*: 58.

Gymnopleurus confuses Mulsant, 1842, *Coléoptères France Lamellicornes*: 57. –Olsoufieff, 1918, *Mémoires du Musée du Caucase*, 7(A): 77 (Syn.).

Gymnopleurus asperatus Mulsant, 1842, *Coléoptères France Lamellicornes*: 58.

Gymnopleurus rugulosus Mulsant, 1842, *Coléoptères France Lamellicornes*: 58.

Gymnopleurus suturalis Mulsant, 1842, *Coléoptères France Lamellicornes*: 58.

Gymnopleurus variolosus Motschulsky, 1849, *Bulletin de la Société Impériale des Naturalistes de Moscou*, 22(3): 102 (ZMUM).

Gymnopleurus conflagratus Motschulsky, 1849, *Bulletin de la Société Impériale des Naturalistes de Moscou*, 22(3): 102 (ZMUM).

Gymnopleurus hornei Waterhouse, 1890, *Annals and Magazine of Natural History*, 5(6): 410 (NHML). –Arrow, 1931, *Fauna British India Lamellicornia*, 3: 55 (Syn.).

Gymnopleurus minor Seabra, 1907, *Estudos Animaes Argricultura*, 4: 75.

Gymnopleurus rufipes Seabra, 1907, *Estudos Animaes Argricultura*, 4: 75.

Gymnopleurus barovskyi Kiseritzky, 1928, *Izvestiya Kursov Prikladnoy Zoologii i Fitopatologii*, 4: 45.

Diagnosis. The head is coarsely and confluently punctured with two strongly elevated oblique bisinuate carinae converging behind, entirely black, dull and coarsely sculptured above. The clypeus is notched in the middle and forms two rounded lobes in front and the pronotum is very coarsely and closely pitted with an incomplete median smooth longitudinal line. Sides are straight in front and strongly rounded behind with the front angles acute, the hind angles very obtuse and the base very feebly rounded. The elytra are rather vaguely striate, with the intervals broken into irregular shining elevations and opaque depressions.

Specimens examined.

[PMNH] 3♀, Nowshera, 14-VI-2007, 1♂2♀, Peshawer, 19-VI-2008, 2♂, Bannu,

26-VIII-2010, 2♂1♀ D. I. Khan, 12-VII-2011, 2♂1♀, Batal, 12-III-2012, 4♂2♀ Mohmad Agency, 23-IV-2013.

[NHML] N. W. India, 1♂, (Type of *Gymnopleurus hornei* Waterhouse, 1890); Alger, 1♀, Nevinson Coll., 1918-14[?]; Taugier, 1♂1♀; Constantine, 2♂3♀; Andalusia Staudinger, 2♂3♀; Kashmir, 4♂6♀; Persia, 2♂3♀; Kara-Kum Desert, south Russia, VI-1912, 1♂; Harwan, 6000 ft., Pohru Valley, Kashmir, 16-V-1928, 1♂, C. F. C. Beeson Coll.; Persian Gulf,; Baluchistan, Ormarah, 1♀, W. D. Cumming Coll.; Iraq, Ba'adra, Near Mosul, 27-V-1934, 1♂1♀, Henry Field Coll.; Turkey, Ankara, Bala distr., Kure Dag, 04-V-1959, 3♂2♀, E. S. Brown Coll.; Spain, Granada, Granada-Mulhacen Rd., Mt. Mulhacen, 2250 m, 21-V-1967, 5♂1♀, M. E. Bacchus & B. Lavey Coll.; Spain, Sa. De Bejar, 4♂7♀, G. C. Champion Coll.; Syria, Damaseus, Zebeuani, 27-VII-1945, 2♂, Middle East Biological Studies Scheme, G. H. Q. & M. E. Y. Coll.; Spain, Sierra de Guadarrama, VIII-1927, 5♂2♀, B. Uvarov Coll.; S. France, La Sainte Baume, 16–18-V-1921, 1♂, K. G. Blair Coll.; S. W. Siberia, in the desert, Nr. Lake Zaisan-Nor, 11-VII-1923, 1♀, G. Bei-Bienko; South Russia, Crnea[Crimea?], 1♂, N. I. Sacharow Coll.

Figure 6. *Gymnopleurus flagellates* (Fabricius, 1787).

[ZMUC] 2♂ (Type of *Scarabaeus flagellatus* Fabricius, 1787); 1♂1♀ (Type of *Scarabaeus flagellatus* var. *major* Fabricius, 1787).

[NMPC] 1♂.

Distribution. Afghanistan; Iran; Turkey; Syria; Iran; Palestine; Morocco; Turkestan; Caucasia; Spain and S. France.

Remarks. Previously recorded by Arrow (1931) in cattle dung on open pasture from Pakistan, species active from late spring to summer.

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